Mapping, Charting and Geodesy Branch
Abstracts of Publications, 1998 and 1999

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Mapping, Charting and Geodesy Branch
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BOOK CHAPTER

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Cobb, M., Foley, H., Petry, F. and **Shaw, K.;** Issues of Uncertainty In Distributed And Interoperable Spatial Information Systems. Published Book Chapter in 1999.

Shaw, K., Chung, M. and Cobb, M.; Migration Process And Consideration For The Object-Oriented Vector Product Format To Objectstore Database Management System. Published Book Chapter in November 1998.

JOURNAL ARTICLES

Wagstaff, R. and **Avera, W.;** Acoustic Vertification Of Nonacoustic Detection Using Fluctuation-Based Processing (U). Published in *The Journal of Underwater Acoustics*, July 1999.

Avera, W.; Development Of An Electrical Conductivity Model With Application To A Submarine ELFE Signature (U). Published in *The Journal of Underwater Acoustics*, July 1999.

Bourgeois, B. Harris, M., Petry, F. and Alleman, P.; A GIS Integration Approach For Dynamically Reconfigurable Surveys. Published in *The Hydrographic Journal,* January 1999. NRL/JA/7442–98-0007.

Bourgeois, B., Martinez, A., Alleman, P., Cheramie, J. and Gravley, J.; Autonomous Bathymetry Survey System. Published in the *IEEE Journal of Oceanic Engineering*, October 1999. NRL/JA/7442–98-0014.

Bourgeois, B. and Martinez, A.; Autonomous Survey System. Published in the *1999 Naval Research Laboratory Review*, April 1999. NRL/PU/5230-99-373.

Bourgeois, B. and Martinez, A.; Depthimeter - Precise Vessel Depth For Bathymetry. Published in the *Marine Geodesy*, November 4, 1999. NRL/JA/7442–99-0006.

Cobb, M., **Chung, M.,** Foley, H., Petry, F., Shaw, K. and Miller, H.; A Rule-Based Approach For The Conflation Of Attributed Vector Data. Published in the GeoInformatica in March

1998. NRL/JA/7441–96-0010.

Harris, M.; Improved Multibeam Survey Accuracy And Efficiency Using Orca. Published in the *Sea Technology*, March 1999. NRL/JA/7440–99-0002.

Holland, K. T.; Beach Cusp Formation And Spacings At Duck, NC. Published in the *Journal of Continental Shelf Research*, Volume 18 (10), August 1998. NRL/JA/7442–96-0018.

Holland, K. T., Holman, R., Stanley, J., Plant, N. and Lippmann, T.; Practical Use Of Video Imagery In Nearshore Oceanographic Field Studies. Published in the *IEEE Journal of Oceanic Engineering*, Volume 22 (1), January 1997. NRL/JA/7442–96-0001.

Holland, K. T. and Holman, R.; Wavenumber-Frequency Structure Of Infragravity Swash Motions. Published in the *Journal of Geophysical Research*, Volume 104, June 15, 1999. NRL/JA/7442–98-0001.

Abdelguerfi, M., Wynne, C., Cooper, E., **Ladner, R.** and Shaw, K.; Representation Of 3-D Elevation In Terrain Databases Using Hierarchical Triangulated Irregular Networks: A Comparative Analysis. Published in the *Int. J. Geographical Information Science*, December 1998, Volume 12, No. 8.

Shaw, K.; PC Based Urban Warfare Practice. Published in the *GEOSPATIAL Times*, Volume 1.2, Summer 1999.

Cobb, M., Foley III, H., **Wilson, R.,** Chung, M. and Shaw, K.; An OO Database Migrates To The Web. Published in the *IEEE Software*, May/June 1998.

Cobb, M., Foley III, H., **Wilson, R.** and Shaw, K.; Migration Of An Object-Oriented Mapping Database To The World Wide Web. Published in the *IEEE Software* in May/June 1998. NRL/JA/7441–97-0013.

NRL FORMAL REPORTS

Lohrenz, M., Gendron, M., Mehaffey, J., Wischow, P., Trenchard, M. and Myrick, S.; AV-8B Map System II: Moving-Map Composer Software Users' Manual. Published as NRL/FR/7441–97-9677, May 1998.

Lohrenz, M., Trenchard, M., Myrick, S., Van Zuyle, P., Perniciaro, R., Gendron, M. and Brown, C.; Digital Map Requirements Study In Support Of Advanced Cockpit Moving-Map Displays. Published as NRL/FR/7441–96-9652, October 1997.

Myrick, S., Lohrenz, M., Wischow, P., Gendron, M., Mehaffey, J. and Riedlinger, L.; Compressed Aeronautical Chart Processing Operator's Manual. Published as

NRL/FR/7441–95-9633, 1998.

Abdelguerfi, M., Ladner, R., **Shaw, K.,** Chung, M. and Wilson, R.; VPF+: A VPF Extension
Suitable For 3D Modeling And Simulation. Published as
NRL/FR/7441–98-9683, August 14, 1998.

NRL MEMORANDUM REPORTS

Morris, H., **Bourgeois, B.,** Petry, F.; Evaluation Of Integrated Remote Sensing And GIS For
Real-Time Bathymetric Data. Published as NRL/MR/7442–98-8217, November 12, 1998.

Bourgeois, B.; ORCA Control System Upgrade Specification, Version 2.00. Published as
NRL/MR/7442–97-8075, December 1997.

Doody III, M., **Breckenridge, J.,** McKay, G. and Perniciaro, R.; Developing a 1:3,000,000
Arctic and Antarctic Regions Shoreline Using the WVS Plus. Published as
NRL/MR/7441–98-8093, December 29, 1998.

Smith, P., **Holland, K. T.** and Arthur, E.; Parameterized Bathymetric Profiles From The Analysis
Of NTM Data. Published Classified as NRL/MR/7342-99-8220, February 1999.

Holland, K. T.; Validation Of The Linear Dispersion Equation Using Field Observations.
Published March 2, 1998. NRL/MR/7442–98-8084.

Landrum, J. L. and Ramsey, S.; Nimamuse Fusion V2.1 Software Requirements. Published
June 25, 1998. NRL/MR/7441–98-8088.

Landrum, J. L. and Ramsey, S.; Nimamuse Fusion V2.1 Test Plan And Test Results. Published
June 25, 1998. NRL/MR/7441–98-8089.

Wischow, P. and **Lohrenz, M.;** Compressed Aeronautical Chart Access Software. Published July
24, 1998. NRL/MR/7441–97-8073.

Lundberg, D., Holland, K. T. and Church, J.; A Semi-Empirical Longshore Current Model.
Published October 24, 1997. NRL/MR/7442–97-8066.

Lundberg, D., Holland, K. T. and Church, J.; Validation Of The Semi-Empirical Longshore
Current Model. Published January 25, 1999. NRL/MR/7442–98-8092.

Trenchard, M., Lohrenz, M., Mehaffey, J. and J. McKee; Aircraft Optical Disk Inventory
Annual Report. Published February 1998. NRL/MR/7441–97-8071.

Trenchard, M., Mehaffey, J., Gendron, M. and Lohrenz, M.; Geographic Coverage Plots For

F/A-18 And AV-8B Aircraft Optical Disk (Fourth Edition). Published February 9, 1998. NRL/MR/7441–97-8072.

Trenchard, M., Gendron, M., Mehaffey, J., Lohrenz, M. and Wischow, P.; Interface Control Document For Mission Planning System Optical Disk Image Version 6+C. Published June 1997. NRL/MR/7441–97-8046.

CONFERENCE PROCEEDINGS

Wagstaff, R., Kinney, W., **Avera, W.,** Bibee, D., Mobbs, J., and Showalter, J.; Acoustic And Nonacoustic Detection Using Conventional And Fluctuation-Based Processing (U). Presented at the 40th Navy Symposium on Underwater Acoustics, March 1999.

Bourgeois, B., Harris, M., Alleman, P., Cheramie, J. and Gravley, J.; Autonomous Bathymetric Surveying. Presented at the 10th International Symposium on Unmanned Untethered Submersible Technology, Durham, NH., September 7-10, 1997. NRL/PP/7442–97-0016.

Bourgeois, B. and Petry, F.; Dynamically Reconfigurable Surveys. Proceedings of the 4th International Conference of Remote Sensing for Marine and Coastal Environments, Orlando, Fl., March 17-19, 1997. NRL/PP/7442–96-0026.

Bourgeois, B. and Harris, M.; In-Situ Hydrographic Support Of Naval Amphibious Operations. Presented at the Hydro '99, IMS, Plymouth, UK, January 1999. NRL/PP/7442–98-0012.

Bourgeois, B. and Martinez, A.; Magnetic Compass Dynamic Performance. Presented at the 11th International Symposium on Unmanned Untethered Submersible Technology, August 23-25, 1999, Durham, NH. NRL/PP/7442–99-0006.

Beaubouef, T., Petry, F. and **Breckenridge, J.;** Rough Set Based Uncertainty Management For Spatial Databases And Geographical Information Systems. Presented to Online World Soft Computing Conference #4, September 18-21, 1999. NRL/PP/7440-99-0009.

Chung, M., Wilson, R., Ladner, R., Shaw, K., Cobb, M., and Lovitt, T.; An Object-Oriented Database Approach For Urban Warfare. Presented at the URISA 1999 Annual Conference, Chicago, IL., August 21-25, 1999. NRL/PP/7441–99-0004.

Chung, M., Wilson, R., Shaw, K. and Cobb, M.; Distributing Mapping Objects With The Geospatial Information Database. Presented at the Distributed Objects/Applications '99, Edinburgh, Scotland, September 5-6, 1999. NRL/PP/7441–99-0002.

Cobb, M., **Chung, M.,** Wilson, R., Shaw, K. and Petry, F.; Spatial Data Mining Using Fuzzy Logic In An Object-Oriented Geographical Information Database. Presented at the Proc. World Multiconference on Systemics, Cybernetics and Informatics, SCI/ISAS '99,

Orlando, Fl., July 31-August 4, 1999.

Hammack, J., Fabre, D., Reed, B. and Hughes-Clarke, J.; Hydrographic Multibeam Processing System (HMPS) Swath Alignment Tool (SAT) Version 1.1. Presented at the Canadian Hydrographic Conference, March 10-12, 1998. NRL/PP/7441–97-0018.

Harris, M. and Bourgeois, B.; Battlespace Environmental Characterization With RMSO. Published in Mine Lines Proceedings, Third International Technical Symposium Technology And The Mine Problem, Monterey, April 6, 1998. NRL/PP/7440–98-0003.

Harris, M. and Bourgeois, B.; Improved Survey Accuracy With Orca. Published in the Marine Technology Society, Ocean Community Conference '98, Volume 1, November 16, 1998. NRL/PP/7440–98-0008.

Holman, R., **Holland, K. T.,** Stockdon, H. and Church, J.; Remote Sensing In The Surf Zone: Non-Traditional Methods In Rapid Environmental Assessment. Presented in proceedings from the Rapid Environmental Assessment Conference Presentation given in SACLANT, Lerici, Italy, March 1997.

Holland, K. T., Vincent, C. and Holman, R.; Statistical Characterization Of Nearshore Morphodynamic Behavior. Published in the Proceedings of Coastal Sediments '99, Volume 3, June 21, 1999. NRL/PP/7442–98-0014.

Holland, K. T., Sallenger, A., Raubenheimer, B. and Elgar, S.; Swash Zone Morphodynamics And Sediment Transport Processes. Presented at ICCE '98, Copenhagen, June 22-26, 1998. NRL/PP/7442–98-0001.

Kalcic, M., Lambert, D. and Martinez, A.; Time-Frequency Analysis Of Acoustic Imagery For Bottom Mapping. Published in the Marine Technology Society OCC '98, Volume 1, November 16, 1998.

Ladner, R. and Abdelguerfi, M.; A Framework For 3D Synthetic Environment Construction And Rendering. Published April 1999. NRL/PP/7441–99-0001.

Ladner, R.; Comparative Analysis of Hierarchical Triangulated Irregular Networks to Represent 3D Elevation in Terrain Databases, Spie Aerosense '97, April 1997.

Abdelguerfi, M., **Ladner, R.** and Shaw, K.; Terrain Database Generation. Presented at the 1998 American Society for Photogrammetry and Remote Sensing Annual Conference, Tampa, FL., April 1998.

Ladner, R., Shaw, K. and Abdelguerfi, M.; 3D Synthetic Environment Representation Using the 'Non-Manifold 3D Winged-Edge' Data Structure. Lecture notes in Computer Science,

Interoperating Geographic Information Systems, Second International Conference, Interop '99, Zurich, Switzerland, March 1999.

Landrum, J. L. and Mejia, P.; A Map Server For Realtime Hydrographic Data Collection Systems. Published in the Marine Technology Society OCC '98, Volume 1, November 16, 1998. NRL/PP/7441–98-0011.

Ruffner, J., **Lohrenz, M.** and Trenchard, M.; Human Factors Issues In The Development Of An Advanced Digital Moving Map System. Presented at the Human Factors and Ergonomics Society International Conference, Houston, TX., September 1999.

Lohrenz, M., Van Zuyle, P., Trenchard, M., Myrick, S. and Fechtig, S.; Optimizing Cockpit Moving-Maps For Enhanced Situational Awareness. Presented at the 1st Annual Symposium and Exhibition On Situational Awareness In The Tactical Air Environment, Patuxent River, MD., June 1997.

Myrick, S.; Digital Chart Database Augmentation with Scanned Paper Charts. Presented at the 61st Annual Journal of the Mississippi Academy of Sciences Program and Abstracts Meeting, 1997.

Myrick, S. and Lohrenz, M.; Use of GIS for Navy Anti-Submarine Warfare and Mine Counter-Measures. Presented at the Southern Symposium on Computing, Hattiesburg, MS., December 1998. NRL/PP/7441–98-0015.

Shaw, K., Abdelguerfi, M. and Ladner, R.; 3D Synthetic Environment Representation Using A Non-Manifold Data Structure. Presented at the Virtual Environment '98, Stuttgart, Germany, June 16-18, 1998.

Shaw, K. and Benetz, C.; Issues And Experiments In Distribution Of Spatial Objects. Published in December 1998. NRL/PP/7441–98-0016.

Shaw, K. and Karam, O.; On Querying In Distributed Spatial Object Databases. Published in December 1998. NRL/PP/7441–98-0019.

Cobb, M., Petry, F. and **Shaw, K.;** Uncertainty Issues Of Conflation In A Distributed Environment. Published in November 1998. NRL/PP/7441–98-0010.

Lovitt, T., Ray, B. and **Shaw, K.;** Using Virtual Reality For Training And Mission Rehearsal. Published in December 1998. NRL/PP/7441–98-0018.

Shaw, K., Abdelguerfi, M. and Ladner, R.; VPF+: A VPF Extension Providing 3D Modeling And 3D Topology. Presented at the 1998 Image Society Conference, Scottsdale, AZ, August 1998. Published in August 1998. NRL/PP/7441–97-0017.

Wilson, R., Chung, M., Shaw, K. and Cobb, M.; A Spatial Indexing Framework Using A Quadtree Organization For Geographic Data Storage And Retrieval. Published in December 1998. NRL/PP/7441–98-0017.

Wilson, R., Chung, M., Lovitt, T., Ray, B., Shaw, K. and Cobb, M.; Design Of A Java Interface To A Smalltalk OO Mapping Database Utilizing Corba. Published in October 1998. NRL/PP/7441–98-0007.

ABSTRACTS

Allard, R., Hsu, L., **Holland, K. T.,** Miles, K., Smith, J., Earle, M. and Nichols, C.; Comparing Coupled Wave/Surf Model To Field Data Collected At Camp Lejeune, NC. Presented at the American Geophys. Union Fall Meeting, San Francisco, CA, December 1998. Abstract OS11B-17.

Holland, K. T. and Sallenger, A.; Foreshore Morphodynamics At Duck, NC. Presented Abstract OS7ZF-12, AGU Fall Meeting, San Francisco, CA., December 1998. NRL/AB/7442–98-0006.

Mettlach, T., **Holland, K. T.** and May, D.; Long-Term Examination Of The Influences On Incipient Wave Breaking. Presented to AGU Spring Meeting, (Abstract), 1999.

Holland, K. T., Su, M. and Burge, R.; Video Imaging Detection Of Surfzone Wave Breaking With Comparsions To In-Situ Void Fraction Measurements. Presented at the American Geophys. Union Spring Meeting, Boston, 1999.

Puleo, J., Allen, J., Holman, R. and Beach, R.; Importance Of Bore-Generated Turbulence To Swash Zone Sediment Transport. Presented to the AGU Fall Meeting in San Francisco, CA., December 1998. NRL/AB/7442–98-0016.

SPECIAL REPORT

Bourgeois, B.; U. S. Naval Research Laboratory: ORCA. Published in the AWEST & AUVSI 1997-98 International Guide to Unmanned Vehicles, June 1997.

Harris, M. and Garner, J.; Mapping, Charting, And Geodesy Branch Abstracts of Publications, Presentations, and Transitions 1996 and 1997. Published June 1998. NRL/AB/7440–98-0001.

Lavoie, D., McDonnell, S., Bowles, F., **Lohrenz, M.,** Starke, S., Czarnecki, M., Fleischer, P., Cherkis, N., Myrick, S., Sawyer, W. and Vermillion, B.; Development Of Mine Warfare And Geoacoustic Data Bases For The Region Surrounding Taiwan. Published as a Special Report, September 30, 1998. NRL/SP/7431–98-0001.

VIDEO

Harris, M., K. T. Holland and K. Shaw; Environmental Measurement Systems For Tactical Support. Released as a Video, September 1997. NRL/OP/7440–97-0004.

List of Acronyms

ADRG   - Arc Digitized Raster Graphics
AOD   - aircraft optical disks
ARC   - equal Arc-second Raster Chart
ASCS   - Acoustic Sediment Classification System

B-rep   - boundary representation

CAC   - Compressed Aeronautical Chart
CDROM   - Compact Disk Read-Only Memory
CORBA   - Common Object Request Broker Architecture

DMA   - Defense Mapping Agency
DMAP   - Digital Mapping, Charting and Geodesy Analysis Program
DMSO   - Defense Modeling Simulation Office
DoD   - Department of Defense
DRS   - dynamically reconfigurable surveying

GIDB   - Geospatial Information Database
GIS   - Geospatial Information and Services
GSF   - Generic Sensor Format

HMPS   - hydrographic multibeam processing system

M&S   - Modeling and Simulation
MC&G   - Mapping, Charting and Geodesy
MDFF   - Map Data Formatting Facility
MMC   - moving map composer
MOMS   - Map-Operator-Maintenance Stations
MUSE   - MC&G Utility Software Environment

NAVAIR   - Naval Air Systems Command
NAVSEA   - Naval Sea Systems Command
NIMA   - National Imagery & Mapping Agency
NOAA   - National Oceanic and Atmospheric Administration

NRL	- Naval Research Laboratory
NSSM	- Navy Standard Surf Model
ODBMS	- object-oriented database management system
OO	- object-oriented
ORCA	- Oceanographic Remotely Controlled Automaton
OVPF	- Object Vector Product Format
PC	- personal computer
PMS	- Program Management System
RMSO	- Remote Minehunting System Oceanographic
RS	- remote sensing
SAT	- swath alignment tool
SEDRIS	- Synthetic Environment Data Representation and Interchange Specification
SPAWARS	- Space and Naval Warfare System
SSC	- Stennis Space Center
3D	- three-dimensional
TIN	- Triangulated Irregular Network
TMPO	- Terrain Modeling Program Office
TS	- Tessellated Spheroid
USMC	- United States Marine Corps
VPF	- Vector Product Format
VRML	- Virtual Reality Modeling Language
WORM	- Write Once, Read Many

(Avera)

ACOUSTIC AND NONACOUSTIC DETECTION USING CONVENTIONAL AND FLUCTUATION-BASED PROCESSING (U)

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Abstract

Abstract is classified.

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ACOUSTIC VERTIFICATION OF NONACOUSTIC DETECTION USING FLUCTUATION-BASED PROCESSING (U)

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Abstract

Abstract is classified.

(Avera)

DEVELOPMENT OF AN ELECTRICAL CONDUCTIVITY MODEL WITH APPLICATION TO A SUBMARINE ELFE SIGNATURE (U)

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Abstract

Abstract is classified.

(Bourgeois)

A GIS INTEGRATION APPROACH FOR
DYNAMICALLY RECONFIGURABLE SURVEYS

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Abstract

This paper defines and discusses dynamically reconfigurable surveying (DRS), an approach to surveying wherein survey conduct is dictated by the data collected instead of by pre-determined lines generated from historical data. The enabling factor in DRS is the ability to process the collected data in-situ so that survey conduct decisions may be made in near real-time. The need to improve survey efficiency is summarized and the way in which DRS can reduce overall survey costs is discussed. The authors investigate in detail the technology requirements to enable DRS, and propose that a GIS fulfills these requirements. The alternate approaches to integration of a GIS into a hydrographic data collection system are developed and evaluated.

AUTONOMOUS BATHYMETRIC SURVEYING

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Abstract

This paper discusses an initial implementation of sensor performance based survey control using a multibeam bathymetric system. The goal of this work is the automation of survey navigation and sensor control utilizing actual vice predicted response of the survey system. The implementation of the techniques discussed in this paper utilized the Naval Research Laboratory's ORCA vessel, a semi-autonomous air-breathing submersible vessel. The approaches attempted are discussed and results from the first at-sea test of these techniques are presented. During the at-sea test data from the multibeam bathymetry system was processed and gridded in real-time, and this data utilized to generate the next navigation trackline for the defined survey area. Sensor performance based control, even with a relatively simple implementation, was seen to compensate extremely well for actual data coverage.

(Bourgeois)

AUTONOMOUS BATHYMETRY SURVEY SYSTEM

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Abstract

This paper discusses the Autonomous Bathymetry Survey System (AutoSurvey), a system that provides automation of swath sonar bathymetric surveys. This system enables faster surveying of an area through environmentally adaptive techniques while ensuring adequate coverage and data quality. AutoSurvey assesses data quality and coverage in real-time and generates next-trackline way-points based on actual system performance. The need for real-time performance assessment is discussed. A primary factor considered is the effect of the environment on swath bathymetry system performance, which is difficult to predict a-priori. The system's features, design and implementation are discussed in this paper. Simulation and sea trial results are presented, as well as an analysis of the system's ability to reduce survey time.

(Bourgeois)

AUTONOMOUS SURVEY SYSTEM

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Abstract

Bathymetric Surveying: For many decades bathymetric surveys have been conducted using vertical single-beam sonar systems. Surveys were conducted using a series of preplanned navigation lines based on historical knowledge of an area's depth, and acoustic imaging systems were used to ensure that shallower areas did not exist between the sounding lines. Modern swath bathymetry systems provide multiple soundings with each sonar ping, within a swath perpendicular to the ship's track. As compared with single-beam Systems, swath systems can provide 100% bottom coverage, yielding denser soundings and faster coverage of an area. Swath systems are typically operated at or near the ocean surface in order to maximize bottom coverage with time. Since a swath sonar covers an angular sector (as large as 1500 for some systems) the actual swath width on the ocean floor varies with ocean depth - narrower in shallow water and wider in deep water. Also, the effective swath width of these systems is adversely affected by environmental conditions such as sea-state, sound velocity profile, bottom morphology and bottom composition. The consequence of these factors is that it is difficult to predict a priori the effective swath width and to preplan navigation lines for minimum survey time while ensuring complete bottom coverage. Consider a simple case, where a series of parallel lines are to be run over an area with a slope, and the lines are oriented perpendicular to the contour of the slope. If planned line spacing is computed using the average depth and the nominal swath width, the result will be excessive overlap between swaths in the deep areas (wasted survey time) and gaps between swaths in the shallow areas (missing data).

(Bourgeois)

EVALUATION OF INTEGRATED REMOTE SENSING
AND GIS FOR REAL-TIME BATHYMETRIC DATA

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Abstract

This paper chronicles a search to find the best integration of Remote Sensing (RS) with GIS for handling bathymetric data. Using the Naval Research Laboratory's (NRL) Oceanographic Remotely Controlled Automaton (ORCA), we have collected bathymetric data over a previously surveyed NOAA site. Due to the cost of survey ship time, we need to optimize the time spent at sea. Providing processed data to the scientists on ship as quickly as possible best does this. To this end, we have evaluated systems that are capable of storing and ingesting large amounts of data, projecting images in near real-time, performing GIS and cartographic functions, and are capable of raster data functionality, particularly neighborhood operations. Many special purpose remote sensing software packages are incapable of performing the GIS and charting functions we require. Likewise, many GIS packages are unable to ingest our voluminous amounts of data, and are totally unable to provide anything resembling our idea of a near real-time GIS. Our final solution is a single package that we hope will be able to integrate the remote sensing and data acquisition features with GIS functionality. We are looking for what is effectively a real-time GIS. We have evaluated 28 different packages and combinations of packages for our system. Our selection and process should prove interesting to anyone who has to deal with bathymetric data.

(Bourgeois)

DEPTHIMETER - PRECISE VESSEL DEPTH FOR BATHYMETRY

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Abstract

This paper describes the design, operation and field testing of the depthimeter. The depthimeter merges heave and acoustically derived vessel depth to form estimates of instantaneous vessel depth and instantaneous sea surface height, both relative to mean sea level. Results from sea trails held in December 1997 demonstrate successful operation of the system.

(Bourgeois)

DYNAMICALLY RECONFIGURABLE SURVEYS

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Abstract

This paper introduces the concept of Dynamically Reconfigurable Survey's (DRS). DRS is a survey methodology that provides dynamic reconfiguration and deployment of sensor systems to meet a prescribed criteria in an optimal manner. Successful implementation of DRS will provide new survey capabilities and a reduction in survey costs. DRS is an outgrowth of the ORCA (Oceanographic Remotely Controlled Automaton) Tactical Response Initiative (OTRI) at the Naval Research Laboratory. ORCA presently provides a rudimentary DRS capability and will soon be capable of a fully autonomous DRS for the collection of bathymetric data with a simple criteria set.

IN-SITU HYDROGRAPHIC SUPPORT OF
NAVAL AMPHIBIOUS OPERATIONS

B. Bourgeois   M. Harris
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

This paper discusses requirements and progress towards providing naval amphibious force with in-situ oceanographic data collection, processing and dissemination. The generation of digital terrain models in real-time is discussed, and is shown to be a key requirement for survey automation. The utility of a GIS for tactical decision making with environmental data is presented. The functional requirements of a GIS to support this task are discussed, as well as recent efforts to utilize GIS in oceanographic data collection and analysis. Finally, data telemetry requirements are reviewed, and the results of preliminary attempts to transmit collected bathymetry data to naval vessels are given.

(Bourgeois)

MAGNETIC COMPASS DYNAMIC PERFORMANCE

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Stennis Space Center, MS 39529-5004
A. Martinez
Tulane University
New Orleans, LA

Abstract

This paper describes the use of a fluxgate compass to provide accurate heading information for autonomous underwater vehicles. Two sources of error are identified: steady-state bias and compass lag. Results of field tests comparing a fluxgate and a reference heading indicate the compass has excellent dynamic performances when both bias and lag compensation are applied. Plans for further laboratory testing of magnetic compass dynamic characteristics are discussed.

(Bourgeois)
ORCA CONTROL SYSTEM UPGRADE SPECIFICATION, VERSION 2.00

B. Bourgeois
Naval Research Laboratory
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Abstract

This memorandum report details the specifications for the upgrade of the ORCA control system that was implemented during the OCT96-MAR97 period. The upgrade to the control system provided the following:

- Supportable versions of software and hardware components.
- Elimination of ORCA control system circuit cards.
- Replacement of electric throttle with supportable hydraulic throttle.
- Installation of low-cost magnetic compass for vessel heading data.
- Automated waypoint following capability.
- Vessel depth feedback to the OSCC (ORCA Sensor Control Computer) via the SPC (Ship Positioning Computer) port.
- Access to control system gains and parameters.
- Upgraded comm link to asynchronous radios with 5 ports.
- Eliminated dependence of PC-SCC (Ship Control Computer, PC version) on discontinued video card.
- Documented radio interface data protocols.
- Copy of proprietary sub-side source code for vessel control system.
- Conversion of the host-ship portion of the control system to a unix system providing:
  - Government ownership of the software.
  - GUI interfaces with popup windows. This results in a more capable operator interface and a reduction in hardware interface components.
  - Gauges for analog parameter readouts.
  - History feature, allowing 'replay' of system parameters.
  - Ethernet only connection between the SCC and OSCC.
  - Allows OSCC to provide backup control of the ORCA.
  - Smart bellypack and navtray that utilize stateless switches and microcontrollers with serial port communication to the SCC.
  - Allows pilot control over the coverage map, video camera, and acoustic obstacle detection system.
- Remote control mode that allows an external computer to control vessel heading, speed and depth.
- Integration of the Tasman GPS unit for vessel positioning.
- Upgrade of Robertson Gyrocompass to enable NMEA output. Inclusion of gyrocompass heading as a control system input.
- Addition of temperature sensors in the electronics bay.

(Bourgeois)

U. S. NAVAL RESEARCH LABORATORY: ORCA

B. Bourgeois
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Company Information: Mapping, Charting & Geodesy Branch, US Naval Research Laboratory (NRL, Stennis Space Center, MS 39529-5004, US. Ph. 601-688-4420; Fax 601-688-4853).

Mission: Swath bathymetry and acoustic imagery. Current profiles, sediment classification, water temp. and conductivity, wave height, other oceanographic data.

Dimensions: Length 25 ft.; width 3.3 ft.; Height 20.7 ft.

Weights: In Air 10,000 lb.; Submerged 100 lb.

Propulsion: 150 hp. engine. Uses diesel fuel. 24 v., 100 A. generator, hydraulic pump.

Performance: Maximum Speed 12 kt.; Maximum Range 288 nm.; Endurance 24 hr.; Operating Depth 0-12 ft.

Payload(s): Multibeam bathymetry/imagery system, north-seeking gyroscope, magnetic compass, vertical reference unit, video camera, below-water obstacle detection, MARS or GPS, Sparc 20 workstation sensor computer, control system computer, surface water conductivity/temp., acoustic Doppler current profiler, wireless ethernet bridge far sensor telemetry.

Guidance & Control Navigation: Teleoperated or autonomous with a range of 2-5 mi.

User Group: US Navy.

Method of Launch/Recovery: Pier-side crone or from survey ship, capable of recovery in sea states 3-5.

(Breckenridge)

DEVELOPING A 1:3000,000 ARCTIC AND ANTARCTIC REGIONS SHORELINE USING THE WVS PLUS

M. Doody III   J. Breckenridge   G. McKay
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
R. Perniciaro
Planning Systems Inc.
Slidell, LA

Abstract

The National/Naval Ice Center (NIC) is currently involved in the creation of an Arctic Sea Ice Atlas for the Environmental Working Group (EWG) Arctic Climatology Project. The NIC is also responsible for creating near real time Arctic ice analysis products for various customers. The Naval Research Laboratory Geographic Information Systems (GIS) Lab has been tasked to assist in the EWG project by creating a shoreline for the Arctic and Antarctic Areas of Interest (AOI) defined by NIC. The creation of these shoreline data sets is in fulfillment of the deliverables of parts 3 and 7 in the Plan of Action and Milestones for the Development of a Spatial Data Transfer Specification Translation of EWG Sea Ice Data for the Naval/National Ice Center. The shorelines are to be used as products by the NIC for present and future operations.

(Breckenridge)

ROUGH SET BASED UNCERTAINTY MANAGEMENT FOR SPATIAL DATABASES AND GEOGRAPHICAL INFORMATION SYSTEMS

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J. Breckenridge
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Abstract

Uncertainty management is necessary for real world applications. This especially holds true for database systems. Spatial data and geographic information systems in particular require some means for managing uncertainty. Rough set theory has been shown to be an effective tool for data mining and for uncertainty management in databases. This paper addresses the particular needs for management of uncertainty in spatial data and GIS and discusses ways in which rough sets can be used to enhance these systems.

(Chung)

A RULE-BASED APPROACH FOR THE CONFLATION
OF ATTRIBUTED VECTOR DATA

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H. V. Miller
Planning Systems Inc.
Stennis Space Center, MS 39529-5004

Abstract

In this paper we present a complete approach for the conflation of attributed vector digital mapping data such as the Vector Product Format (VPF) datasets produced and disseminated by the National Imagery and Mapping Agency (NIMA). While other work in the field of conflation has traditionally used statistical techniques based on proximity of features, the approach presented here utilizes all information associated with data, including attribute information such as feature codes from a standardized set associated data quality information of varying levels, and topology, as well as more traditional measures of geometry and proximity.

In particular, we address the issues associated with the problem of matching features and maintaining accuracy requirements. A hierarchical rule-based approach augmented with capabilities for reasoning under uncertainty is presented for feature matching as well as for the determination of attribute sets and values for the resulting merged features. Additionally, an in-depth analysis of horizontal accuracy considerations with respect to point features is given.

An implementation of the attribute and geometrical matching phases within the scope of an expert system has proven the efficacy of the approach and is discussed within the context of the VPF data.

AN OBJECT-ORIENTED DATABASE APPROACH
FOR URBAN WARFARE

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R. Ladner   K. Shaw
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Stennis Space Center, MS 39529-5004
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Abstract

The Naval Research Laboratory has developed a Geospatial Information Database (GIDB) database using Object-Oriented Database. Common Object Request Broker Architecture (CORBA), and Virtual Reality Modeling Language (VRML) technology for the Marine Corps. The GIDB allows the integration of all digital mapping data types (e.g., raster, vector, text, audio and video) into a single database that can be signaled from a simple browser and directed by any area-of-interest. This technology will provide military and the commercial sector significant new abilities to select any urban area-of-interest and receive all related mapping objects via the Internet. The GIDB also enables constrained queries to allow Internet users to limit the provided objects to declutter the display (e.g., display only buildings within 500 meters of the coast for hurricane studies along with all related video and audio clips or only display roads where imagery is available as a background). The GIDB allows anyone with a simple Internet browser to interact with the database to signal portions of interest in the database to render itself in 3D, update itself, etc. The GIDB was utilized by the Marine Corps in the March 99 Urban Warrior exercise aimed at improving command and control in the Urban environment.

(Chung)

DISTRIBUTING MAPPING OBJECTS WITH THE
GEOSPATIAL INFORMATION DATABASE

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M. Cobb
University of Southern Mississippi
Hattiesburg, MS 39406-5106

Abstract

The Geospatial Information Database (GIDB) is an implementation of on going research in object-oriented geographic data modeling at the Naval Research Laboratory's Mapping, Charting & Geodesy Branch. The GIDB has evolved over the last five years from the initial memory-resident application involving vector mapping data, to the current state-of-the-art system of a distributed object-oriented database with web-based viewing capabilities for vector, raster, hypertext and multimedia data, as well as remote updating of vector data.

The use of geographic data is becoming pervasive across many disciplines. At the same time, end users are becoming increasingly dependent upon the web as a source of readily available, easily accessible information. We believe these two factors necessitate the development of systems capable of the immediate distribution and access to complex spatial data objects. The GIDB was designed and developed to till this need. The evolution of the GIDB required many supporting technologies, including a commercial object-oriented database management system, appropriate middleware (CORBA 2.0 object request brokers) and, of course, object-oriented programming languages. In this paper, we present the design strategies and implementation architecture of the GIDB and show how these can be used as a model for distributed geographic information systems.

SPATIAL DATA MINING USING FUZZY LOGIC IN AN OBJECT-ORIENTED GEOGRAPHICAL INFORMATION DATABASE

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Abstract

The Mapping Sciences Section of the Naval Research Laboratory, Stennis Space Center, has realized the enormous benefits of spatial data warehousing and database integration with the implementation of the Geospatial Information Database (GIDB). An object-oriented approach was used to develop an object model that could be easily expanded to include all geographic data types. With the base of object-oriented technology, standards such as Common Object Request Broker Architecture (CORBA) and Virtual Reality Modeling Language (VRML) enabled 2-dimensional as well as 3-dimensional display over the internet.

However, in the process of developing the GIDB system, the question of what to do with all the data became an inevitable question. Data exist to be used and exploited by users, but what can users do with all the data? Is the availability of so much information overwhelming to the users? The use of spatial data mining techniques to help users make sense of the wealth of data in the GIDB is the focus of this paper. After general discussions of the topic of spatial data mining, we then present a specific technique for integrating a fuzzy set model for spatial relationship determination with the object-oriented model of the GIDB.

(Hammack)

HYDROGRAPHIC MULTIBEAM PROCESSING SYSTEM (HMPS)
SWATH ALIGNMENT TOOL (SAT) VERSION 1.1

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Canada

Abstract

The Mapping, Charting, and Geodesy Branch the Naval Research Laboratory in conjunction with Neptune Science, Incorporated; and the University of New Brunswick have developed software for the determination of system alignment errors and the verification of system performance for fixed-mount multibeam swath sonar systems. The HMPS SAT is designed to work with Generic Sensor Format (GSF) data files now in use by the Naval Oceanographic Office for the processing of hydrographic sonar data. The use of GSF allows the software to be used for the identification of alignment errors on various swath sonar Systems without modification. Among them have been an Oceanographic Remotely Controlled Automaton (ORCA) vessel with its Simrad BM-1000 multibeam and the BM-121A mounted to a TAGS-60 vessel. One of the authors recently attended the United States/Canada Hydrographic Commission Coastal Multibeam Training Course and was able to use the SAT with Reson SEABAT 9001 data which was stored in GSF.

The alignment software has also been designed in a modular fashion using standard programming languages and techniques. It has been tested on several computer systems, including Silicon Graphics, Hewlett-Packard, DEC Alpha, and Sun workstations. It has also been ported to a Pentium PC computer system running Linux. It can be used at sea for the determination of system errors before beginning a survey, during a survey as a means of quality control, and ashore during post processing to verify proper system performance.

(Harris)

BATTLESPACE ENVIRONMENTAL CHARACTERIZATION WITH RMSO

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Stennis Space Center, MS 39529-5004

Abstract

Environmental information in the Littoral Battle Space can be used to gain tactical advantage in Mine Warfare, Amphibious Warfare and Special Warfare Missions, Environmental measurements and derived information of interest in the littoral include swath bathymetry, acoustic imagery of the seafloor, current profiles, salinity, hazards to navigation, temperature, bioluminescence, wave heights, water clarity, seafloor bottom types and mine burial potential, and wind information. NRL is developing the Remote Minehunting System, Oceanographic Variant, (RMSO) as a technology option for the Navy. The vehicle will be able to collect and radio transmit measurement information to a host vessel. The initial sensor suite will provide swath bathymetry, seafloor acoustic imagery, wave conditions, water temperature and salinity. Several other sensors have been demonstrated on the prototype Oceanographic Remotely Controlled Automaton (ORCA) including a seafloor sediment classification system, and current profiler which can be added to the RMSO vehicle. Future meteorological and water optical sensors installations are also achievable. This paper briefly describes RMSOs initial sensor suite and potential future sensors as a technology option to characterize the Littoral Battle Space Environment.

(Harris)

IMPROVED MULTIBEAM SURVEY ACCURACY AND EFFICIENCY USING ORCA

M. Harris
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The advent of multibeam bathymetry systems, which are capable of total seafloor ensonification, have made fundamental changes in hydrography. The new IHO S-44 standards challenge hydrographers to achieve even greater depth and position accuracy with multibeam systems. Using the multibeam system on the ORCA vehicle, incremental improvements have been made in each of these areas as demonstrated in a series of at sea survey tests. Improvements have been made to the system that allow: collection of data during turns; an order of magnitude improvement in heading measurement; and accurate measurement of vessel depth with respect to mean sea-level. Data collection during turns was achieved using a sensor that integrates inertial and GPS signals. Heading accuracy has been improved by going from a gyro based measurement system to a dual-antenna GPS phase differencing system. In addition to more accurate placement of soundings, especially in the outer beams, the system components are smaller and require less power than those replaced. Vessel depth measurements are made with a high-frequency altimeter, which also yields sea surface information including wave height, period, number and direction. An autonomous surveying capability has been developed to achieve the desired ensonification of the seafloor without over or under surveying an area. Coverage is based on the quality of data in the outer beams and the desired overlap in coverage. This paper describes changes made to NRL's multibeam system, and provides comparative results from system testing.

(Harris)

IMPROVED SURVEY ACCURACY WITH ORCA

M. Harris   B. Bourgeois
Naval Research Laboratory
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Abstract

The advent of multibeam bathymetry systems, which are capable of total seafloor ensonification, have made fundamental changes in hydrography. The new IHO S-44 standards challenge hydrographers to achieve even greater depth and position accuracy with multibeam systems. ORCA has made incremental improvements in each of these areas as demonstrated in a series of at sea survey tests. Improvements have been made to the system that allow collection of data during turns, an order of magnitude improvement in heading measurement, and accurate measurement of vessel depth with respect to mean sea-level. Data collection during turns was achieved using a sensor that integrates inertial and GPS signals. Heading accuracy has been improved by going from a gyro based measurement system to a dual-antenna GPS phase differencing system. In addition to more accurate placement of soundings, especially in the outer beams, the system components are smaller and require less power than those replaced. Vessel depth measurements are made with a high-frequency altimeter, which also yields sea surface information including wave height, period, number and direction. An autonomous surveying capability has been developed to achieve the desired ensonification of the seafloor without over or under surveying an area. Coverage is based on the quality of data in the outer beams and the desired overlap in coverage. This paper describes the sensor and software changes made to the ORCA, and provides comparative results from system testing.

(Harris)

MAPPING, CHARTING, AND GEODESY BRANCH
Abstracts of Publications,
Presentations, and Transitions 1996 and 1997

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Stennis Space Center, MS 39529-5004

Abstract

This document presents abstracts of the 1996 and 1997 publications of the Mapping, Charting, and Geodesy Branch, Naval Research Laboratory, Stennis Space Center, MS 39529-5004.

(Harris)

VIDEO - ENVIRONMENTAL MEASUREMENT SYSTEMS FOR TACTICAL SUPPORT IN THE LITTORAL

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Abstract

RMS-O is a fully supportable vehicle with an endurance of three days at 10 kts. It is intended to provide combatants with an organic environmental data collection capability and survey ships a cost effective force multiplication capability for the next 30 years. Research and development efforts in environmentally adaptive autonomous surveys and near-real-time tactical data products enhance the effectiveness of the RMS-O and are priority efforts in the survey navy's path leading to use of totally autonomous underwater vehicles. RMS-O provides the Navy a cost effective low-risk path to greater flexibility in the acquisition of environmental data to characterize the littoral region.

BEACH CUSP FORMATION AND SPACINGS
AT DUCK, NC

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Abstract

This investigation involved the analysis of nearly nine years of video imagery from Duck, NC to determine the timing of cusp formation (to within half a day) and the distances separating consecutive cusp horns (to within half a meter). Supplementary data provided by nearshore instrumentation and surveying vehicles was used to document the environmental conditions during cusp development. These extensive observations conclusively demonstrate that cusps at this location develop following storms during the transition from high energy to low energy wave conditions as the wave angle approaches normal incidence. The average cusp width over the 57 independent cusp events was approximately 25 m. The mean variation within an individual cusp system from the average cusp spacing was about 15%. A peculiar suggestion of historisis within the cusp spacing time series was observed and may suggest that existing theories of cusp formation need to be reformulated.

COMPARING COUPLED WAVE/SURF MODEL TO FIELD DATA COLLECTED AT CAMP LEJEUNE, NC

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Sverdrup Technology, Inc.
Stennis Space Center, MS 39529-5004
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Coastal and Hydraulics Laboratory
Vicksburg, MS 39180
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Reston, VA 20190

Abstract

Nearshore ocean surface wave, surf, water level, and wind data were collected at Camp Lejeune, Onslow Bay, NC from 24 Aug to 6 Sep 1997 to validate a coupled wave and surf modeling system. The field work coincided with a military exercise so the value of the data and modeling system also could be demonstrated for operational applications. Instrumentation included three Neptune Sciences' small wave buoys being developed for the Navy, five Sea-bird wave and tide gauges, four prototype expendable wave and tide gauges, a shore mounted weather station, and a shore mounted surf zone measurement video system. The waves measured during the period were representative of summer conditions with wave heights ranging from 0.2 to 1.0 m one mile offshore and 0.4 to 1.2 m just outside the surf zone. Wave periods generally ranged from 4 to 10 s. Winds measured on the beach were generally from the east and southeast with speeds typically between 2 and 9 m/s. There were no significant storms during the period, but two cold fronts pushed through the area.

In the modeling approach, a deep water WAM model was coupled independently to the shallow water wave models, STWAVE or REF/DIF1. Outputs from both models drove the most recent version of the Navy Standard Surf Model (NSSM) which provided detailed information (e.g. breaker heights, breaker types, longshore currents) across the surf zone. Water levels (a surf model input) were calculated from the hydrodynamic model, ADCIRC. Wind input to WAM and STWAVE were obtained from the Navy Operational Regional Atmospheric prediction System. Results from the wave and surf modeling system are compared with the collected in-situ data. The video data are used to estimate wave periods, wave angles, wave speeds, longshore currents, and surf zone widths for additional comparisons.

(Holland)

FORESHORE MORPHODYNAMICS AT DUCK, NC

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A. Sallenger
US Geological Survey

Abstract

Most prior attempts at modeling the evolution of swash zone morphology has lacked simultaneous measurements of the interaction between hydrodynamic and morphodynamic forces over relatively large temporal and spatial scales (hours to days and 10s to 100s of meters, respectively). Recent advances in technology show promise for providing such measurements in this dynamic region through the use of a stereometric video technique capable of measuring three-dimensional foreshore morphology to roughly centimeter accuracy [*Holland and Holman,* 1997]. This method monitors the progression of the swash edge over a single wave cycle and typically samples several thousand estimates of the foreshore surface in addition to measurement of the 3-D swash edge time series.

Measurements of foreshore surfaces and swash motions sampled during the Duck94 and SANDYDUCK experiments at Duck, NC showed distinctive patterns of net sediment transport and morphologic change in response to hydrodynamic forcing. Estimates were made over study regions of up to 50 m in the cross-shore and 100 m in the along shore. Analysis of these observations showed erosion rates of up to 0.25 m³/hr. These rates were partially correlated with spatial gradients in swash flow velocity, however, the magnitudes predicted by a simple sediment transport model were dissimilar to observations suggesting that other factors, including groundwater and tidal influences could be equally important. Of particular interest were instances where forcing conditions were approximately equivalent, yet morphologic response was dramatically dissimilar. Also monitored was an almost complete cycle of cusp development and destruction.

LONG-TERM EXAMINATION OF THE INFLUENCES
ON INCIPIENT WAVE BREAKING

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K. T. Holland
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
D. May
US Naval Oceanographic Office
Stennis Space Center, MS 39529-5004

Abstract

The Naval Research laboratory's Remote Sensing Applications Branch and Marine Geosciences Division Mapping, Charting and Geodesy Branch have evaluated the accuracy of Navy Surf Model-derived surf zone width estimations. Accurate estimates of surf zone width have became increasingly important for mine countermeasures and amphibious warfare operations. The model is initialized using high quality in situ meteorological, oceanographic and hypsometric data. Model results are compared to surf zone width determined from Argus video imagery acquired at the U.S. Army Corps of Engineers, Field Research Facility, Duck, NC from June 1996 to June 1997 and to results from the Reniers and Battjes (1997) wave transformation model. From 665 video-derived surf zone widths, ranging from 5 to 400 meters, the root-mean-square error in model-derived surf zone width is approximately 30 meters and the mean error is less than 5 meters. The most offshore location where the navy model estimates 10 percent wave breaking is best correlated with the location of incipient wave breaking. However, the correlation of cases with onshore wind and with offshore wind are significantly different, suggesting that wind plays a role in wave breaking processes. Several multiple linear correlation models are developed and used to determine the greatest influences on incipient wave breaking, which are the offshore wave field, the nearshore depth profile and the onshore wind speed. Air-sea temperature differences are shown to be insignificant.

Presented to AGU Spring Meeting, 1999.
Abstract

(Holland)

PARAMETERIZED BATHYMETRIC PROFILES FROM
THE ANALYSIS OF NTM DATA

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Stennis Space Center, MS 39529-5004

Abstract

Naval Research Laboratory Classified Memorandum Report Number 7342-99-8220.

PRACTICAL USE OF VIDEO IMAGERY IN NEARSHORE OCEANOGRAPHIC FIELD STUDIES

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T. Lippmann
University of California
La Jolla, CA 92037

Abstract

An approach was developed for using video imagery to quantify naturally occurring physical processes in terms of both spatial dimensions and temporal relationships. This approach is founded on the principles of photogrammetry, accounts for difficulties inherent in the use of video signals, and has been adapted to allow for flexibility of use in a field environment. The complete method is presented, including the derivation of the geometrical relationships relating image and ground coordinates, principles to be considered when working with video signals and the two-step strategy for calibration of the camera model. Examples from field tests indicate that this approach is both accurate and applicable under the conditions typically experienced when sampling in coastal regions. Several applications of the camera model to the measurement of surfzone fluid processes and topographic features are discussed. Although our application of this approach has been directed towards the measurement of nearshore processes and bathymetric features, these same techniques are very likely useful in the study of other oceanographic phenomena.

REMOTE SENSING IN THE SURF ZONE: NON-TRADITIONAL METHODS IN RAPID ENVIRONMENTAL ASSESSMENT

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J. Church
C&C Technologies
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Abstract

Naval forces have developed an increasing interest in very shallow water and surf zone regions. Optimum use of the environment requires knowledge of a range of properties from depth profiles to wave heights and current strengths. These usually must be measured remotely, a challenge given the large spatial gradients of the nearshore.

Techniques have been developed based on video imagery from fixed platforms. Generalities of the sampling problem are discussed long with the concepts underlying each technique. The main complications of transition to moving platforms are related to the statistical consequences of the different sampling capabilities.

STATISTICAL CHARACTERIZATION OF
NEARSHORE MORPHODYNAMIC BEHAVIOR

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Abstract

The stability of nearshore sand bars was investigated using a long-term, video-derived, dataset. The cross-shore position of the inner sand bar relative to the shoreline at Duck, N.C., was observed to be at approximately the same mean location over multi-year time intervals, but varied dramatically over much shorter time scales on the order of a few days. The simple, lowest order model that the Duck inner bar is stable at a location of 87 m will result in a root-mean-square error of over 25 m. In contrast, nonlinear forecasting methods, which use past behavior as the model basis, showed greater skill in predicting bar change, having a prediction horizon for significant forecasts on the order of five days. The observations and the data in general, suggest that other deterministic models of bar behavior may be limited to forecasts of only a few days because of a strong sensitivity to initial conditions.

SWASH ZONE MORPHODYNAMICS
AND SEDIMENT TRANSPORT PROCESSES

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A. Sallenger
USGS Center for Coastal Geology
St. Petersburg, FL 33701
B. Raubenheimer   S. Elgar
Washington State University
Pullman, WA 99164-2752

Abstract

While it is generally recognized that the swash zone stands as the definitional boundary of shoreline change and contributes a major portion to the total nearshore sediment flux, the present understanding of basic sediment transport mechanisms in this region is poor. Understanding is often constrained by the complexity and richness of foreshore processes, which are typically nonlinear and have the potential for feedback between forcing and response. In addition, making detailed and meaningful measurements in this dynamic region is difficult.

Several previous studies of swash zone morphology and associated sediment transport exist. A number of researchers have used coarsely sampled changes in bed elevation to infer total load sediment transport rates in the swash zone [*Duncan*, 1964; *Waddell*, 1976; *Sallenger and Richmond*, 1984; *Howd and Holman*, 1987]; while others have used either instruments or traps to monitor suspended and bedload concentrations [*Beach et al.*, 1992; *Horn and Mason*, 1994]. Even though these findings have increased our knowledge, modeling the evolution of swash zone morphology [see *Kabling and Sato*, 1994] has been somewhat unsuccessful because of the lack of simultaneous measurements of the hydrodynamic and morphodynamic interactions over relatively large temporal and spatial scales (hours to days and 10s to 100s of meters, respectively).

Recent advances in technology show promise for providing such measurements. A stereometric video technique has been developed that is capable of measuring three-dimensional (3D) morphology to roughly centimeter accuracy by monitoring the progression of the swash edge over a single wave cycle [*Holland and Holman*, 1997]. This method typically samples several thousand estimates of the foreshore surface per wave in addition to measurement of the 3D swash edge time series at a sampling frequency of up to 30 Hz.

(Holland)

VALIDATION OF THE LINEAR DISPERSION
EQUATION USING FIELD OBSERVATIONS

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Stennis Space Center, MS 39529-5004

Abstract

The Naval Research Laboratory working with representatives from the Naval Meterology and Oceanography Command, the Naval Oceanographic Office, the Office of Naval Research, MEDEA, and MITRE, was tasked to investigate and validate two existing satellite remote sensing methods for determining bathymetry. Both of these methods utilize the linear, finite depth, dispersion equation for surface gravity waves to determine water depth from measurements of wavenumber magnitude as a function of frequency. Although the main objective of the team's efforts was to quantify the accuracy and efficiency of each method, a secondary task was to identify possible error sources resulting from the use of the dispersion relation under field conditions. This publication describes the results of the dispersion relation validation effort.

Several hundred observations of wavenumber magnitude for frequencies less than 0.3 Hz were obtained over a wide variety of conditions at the Duck, NC field site. These data were computed using sophisticated signal processing algorithms that yield precise estimates of wavenumber that were used to predict water depths assuming the linear dispersion relation. For water depths outside the surf zone region, the results indicate that the linear dispersion relation was highly accurate, with average depth estimation errors on the order of 6% of the observed depth. In shallower regions where wave breaking is evident and nonlinear effects are more pronounced, nominally 4 m and less for Duck, discrepancies between measured and predicted depths of well over 50% were observed.

Correlations between the magnitude of the depth error and measured wave amplitudes suggest the importance of wave amplitude in the calculation of shallow water phase speeds, and correspondingly in the use of the dispersion relation in the surf zone region.

VIDEO IMAGING DETECTION OF SURFZONE WAVE BREAKING WITH COMPARISONS TO IN-SITU VOID FRACTION MEASUREMENTS

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Abstract

During both Sandy Duck 97 and Duck 99 Experiments at Duck, SC we mounted a color video camera on the top of the CERC FRF tower (42m in height). The field of view of this video mainly covers the near-shore zone from the beach to about 500m offshore, where our three (Sandy Duck 97) and five (Duck 99) void fraction arrays were deployed. In this paper, we shall present some results from the analysis of these video images taken during windy conditions when many breaking waves were observed, and also during low wind conditions when the low tide caused many swells to break near the surfzone.

The time-lapsed large-area average over 5 to 10 minutes of these video images give clear zonal probability of wave breaking. On the other hand, variations of image intensity over a small area (averaging over a few pixels) gives the temporal characteristics of progressive breaking waves over the surfzone. Some correlation between the statistical video image intensity with those of the in-situ void fraction measurements obtained by conutcivity-type gauges will also be made.

WAVENUMBER-FREQUENCY STRUCTURE
OF INFRAGRAVITY SWASH MOTIONS

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Abstract

Alongshore separated time series of natural swash motions on a barred beach were obtained over a range of environmental conditions using a video technique. Wavenumber-frequency spectra of these data were computed to partition infragravity band energy levels associated with various wave types. For the frequencies $0.025 < f \le 0.05$Hz, $45\% \pm 13\%$ (one standard deviation) of the shoreline variance was associated with high mode ($n \ge 2$) edge waves and/or leaky waves, while approximately half of that amount was associated with low mode edge waves. Although gravity wave motions were also observed in a lower frequency band ($0.001 < f \le 0.025$ Hz), a substantial portion of the variance ($21 \pm 10\%$, with a maximum of 38%) was identified as a nondispersive wave form with wavenumbers well outside of the wavenumber-frequency bounds for gravity waves. This nongravity swash variance showed no significant dependence on mean alongshore current strength or mean alongshore current shear as measured in the surf zone. In addition, the celerities of these nondispersive waves measured in the swash zone were found to differ in magnitude, and in one instance sign, from celerities measured further offshore, implying a decorrelation of trough and shoreline fluid motions.

TIME-FREQUENCY ANALYSIS OF ACOUSTIC IMAGERY
FOR BOTTOM MAPPING

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Abstract

Acoustic imagery generated by the Naval Research Laboratory's ASCS (Acoustic Sediment Classification System) is analyzed using time-frequency methods. The ASCS imagery is generated using normal-incidence acoustic data. Nonlinearities in the propagating medium produce multiple harmonics in the return. Different components of the bottom and sub-bottom produce different spectral signatures, based on the harmonics that can be used to classify the bottom. Although the exact acoustic properties of the media may not be known, it is possible to segment the spectrally different components. This paper presents an efficient method for performing the time-frequency analysis. The tradeoffs between time and frequency resolution are examined and exploited to produce the best overall resolution. Examples using the ASCS data demonstrate its use for classification of acoustic imagery. Buried pipes, methane gas deposits, and other features can be differentiated using this method.

A FRAMEWORK FOR 3D SYNTHETIC ENVIRONMENT CONSTRUCTION AND RENDERING

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Abstract

The Naval Research Laboratory's Digital Mapping, Charting, and Geodesy Analysis Program (DMAP) is investigating the extension of the National Imagery and Mapping Agency's (NIMA) Vector Product Format (VPF) to handle a wide range of non-manifold 3D objects for modeling and simulation. The extended VPF, referred to as VPF+, makes use of a non-manifold data structure for modeling 3D synthetic environments. The data structure uses a boundary representation (B-rep) method. B-rep models 3D objects by describing them in terms of their bounding entities and by topologically orienting them in a manner that enables the distinction between the object's interior and exterior. Consistent with B-rep. the representational scheme of the proposed data structure includes both topologic and geometric information. The topologic information encompasses the adjacencies involved in 3D manifold and non-manifold objects, and is described using a new extended Winged-Edge data structure. This data structure is referred to as "Non-Manifold 3D Winged-Edge Topology". VPF+ also adds a new simple feature class of dimension three, referred to as 3D Object Feature. VPF+ is being prototyped in a Web-based virtual reality application. Functionality includes the ability to walk through or fly over the terrain to move around objects, to enter buildings, display floor plans, etc.3D terrain representation plays

(Ladner)

COMPARATIVE ANALYSIS OF HIERARCHICAL TRIANGULATED IRREGULAR NETWORKS TO REPRESENT 3D ELEVATION IN TERRAIN DATABASES

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Abstract

3D terrain representation plays an important role in a number of terrain database applications. Hierarchical Triangulated Irregular Networks (TINs) provide a variable-resolution terrain representation that is based on a nested triangulation of the terrain. This paper compares and analyzes existing hierarchical triangulation techniques. The comparative analysis takes into account how aesthetically appealing and accurate the resulting terrain representation is. Parameters, such as adjacency, slivers, and streaks, are used to provide a measure on how aesthetically appealing the terrain representation is. Slivers occur when the triangulation produces thin and slivery triangles. Streaks appear when there are too many triangulations done at a given vertex. Simple mathematical expressions are derived for these parameters, thereby providing a fairer and a more easily duplicated comparison. In addition to meeting the adjacency requirement, an aesthetically pleasant hierarchical TINs generation algorithm is expected to reduce both slivers and streaks while maintaining accuracy. A comparative analysis of a number of existing approaches shows that a variant of a method originally proposed by Scarlatos exhibits better overall performance.

REPRESENTATION OF 3-D ELEVATION IN TERRAIN DATABASES USING HIERARCHICAL TRIANGULATED IRREGULAR NETWORKS: A COMPARATIVE ANALYSIS

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Abstract

3-D terrain representation plays an important role in a number of terrain database applications. Hierarchical Triangulated Irregular Networks (TINs) provide a variable-resolution terrain representation that is based on a nested triangulation of the terrain. This paper compares and analyzes existing hierarchical triangulation techniques. The comparative analysis takes into account how aesthetically appealing and accurate the resulting terrain representation is. Parameters such as adjacency, slivers, and streaks, are used to provide a measure on how aesthetically appealing the terrain representation is. Slivers occur when the triangulation produces thin and slivery triangles. Streaks appear when there are too many triangulations done at a given vertex. Simple mathematical expressions are derived for these parameters, thereby providing a fairer and a more easily duplicated comparison. In addition to meeting the adjacency requirement an aesthetically pleasant hierarchical TINs generation algorithm is expected to reduce both slivers and streaks while maintaining accuracy. A comparative analysis of a number of existing approaches shows that a variant of a method originally proposed by Scarlatos exhibits better overall performance.

TERRAIN DATABASE GENERATION

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Abstract

Applications requiring highly accurate and detailed Terrain Databases (TDBs) have developed beyond military modeling, simulation and training into such areas as rainfall-runoff models, transportation network development, and utility automated mapping facilities management (AM/FM). These TDBs incorporate digital terrain data with various natural and man-made features (in 2 and 3 dimensions) to ensure a seamless and consistent view of the area being modeled. A single or multiple resolution grid or Triangulated Irregular Networks (TINs) are common ways of storing the initial terrain representation. Two different approaches to integrating terrain and features in a consistent manner may be appropriate. One drapes features over the terrain with or without modifying the underlying terrain TIN. The other stores terrain and feature data as a single collection of primitives and features. Levels of Detail (LODs) allow the user to access varying resolutions of detail of the area being modeled depending on the "viewing" distance. These processes by which the real world is modeled by TDBs and of the types and sources of data so used are overviewed in this paper.

3D SYNTHETIC ENVIRONMENT REPRESENTATION USING THE 'NON-MANIFOLD 3D WINGED-EDGE' DATA STRUCTURE

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Abstract

A Non-Manifold data structure for the modeling of 3D synthetic environments is proposed. The data structure uses a boundary representation (B-rep) method. B-rep models 3D objects by describing them in terms of their bounding entities and by topologically orienting them in a manner that enables the distinction between the object's interior and exterior. Consistent with B-rep, the representational scheme of the proposed data structure includes both topologic and geometric information. The topologic information encompasses the adjacencies involved in 3D manifold and non-manifold objects, and is described using a new, extended Winged-Edge data structure. This data structure is referred to as "Non-Manifold 3D Winged-Edge Topology". The time complexity of the newly introduced data structure is investigated. Additionally, the Non-Manifold 3D Winged-Edge Topology is being prototyped in a Web-Based virtual reality application. The prototype data consists of Military Operation in Urban Terrain (MOUT) data for Camp LeJeune, North Carolina. The application is expected to be ideal for training and simulation exercises as well as actual field operations requiring on-site assistance in urban areas.

(Landrum)

A MAP SERVER FOR REALTIME HYDROGRAPHIC DATA COLLECTION SYSTEMS

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Abstract

The Oceanographic Remotely Controlled Automaton (ORCA) is a prototype Naval hydrographic/oceanographic survey system operated from a mother ship (Figure 1). Measurements are radioed to a control station on the mother ship, logged, and displayed in real time. A decluttered and customized chart background was needed to expand situational awareness. This paper describes the adaptation of an existing government map application program to provide the needed map services to the ORCA control station. Many hydrographic surveys are conducted in areas for which charts exist in some form and at some scale, often for the purpose of updating the existing chart or perhaps producing a chart at a larger scale. The ready availability of the pre-existing chart data may provide a valuable aid in the selection of survey platform and equipment and in planning the actual survey tracks, so as to properly investigate suspected navigation hazards such as underwater wrecks and other obstructions.

(Landrum)

NIMAMUSE FUSION V2.1 SOFTWARE REQUIREMENTS

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Abstract

NIMAMUSE Fusion V2.1 is a computer mapping software program produced by NRL for the National Imagery and Mapping Agency (NIMA). In addition to demonstrating the NIMA digital map data products coordinate conversions and datum transformations, Fusion provides general purpose mapping capabilities for managing user data, route planning, and route monitoring. This report presents the software requirements for Fusion V2.1.

(Landrum)

NIMAMUSE FUSION V2.1 TEST PLAN AND TEST RESULTS

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Abstract

NIMAMUSE Fusion V2.1 is a computer mapping software program produced by NRL for the National Imagery and Mapping Agency (NIMA). In addition to demonstrating the NIMA digital map data products, coordinate conversions, and datum transformations, Fusion provides general purpose mapping capabilities for managing user data, route planning, and route monitoring. This report describes a series of tests to determine how well Fusion V2.1 meets its functional requirements and presents the results of performing the tests.

(Lohrenz)

AV-8B MAP SYSTEM II: MOVING-MAP COMPOSER
SOFTWARE USERS' MANUAL

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Abstract

This report documents the Moving-Map Composer (MMC) software system developed by scientists in NRL Code 7441. The MMC software is resident on the AV-8B Map-II Station, which NRL designed and configured in support of AV-8B mission planners and pilots in the field. These MMC-driven Map-II Stations enable AV-8B users to perform the following functions:

- Design and build Aircraft Optical Disk (AOD) images from user-specified Compressed Aeronautical Chart (CAC) and scanned chart data;
- Include emergency check-lists and reconnaissance photographs in an AOD image;
- Write completed AOD images to militarized Write-Once Read-Many AODs;
- Evaluate failed AODs and recover from failed AOD image builds;
- Design and build Mission Planning System Compact Disk Images (MPS-CDIs) from user-specified CAC, scanned chart, and DTED data;
- Write MPS-CDIs to Recordable Compact Disk (CD-R) for mission planning purposes;
- Scan and compress paper charts into a CAC-compatible format (when CAC or Arc Digitized Raster Graphics (ADRG) are not available) and include them in an AOD image or MPS-CDI.

These Map-II Stations image functions will completely replace all map data functions and all optical disk image functions that are currently handled by the AV-8B Map, Operator, and Maintenance Stations (MOMS). To date, the AV-8B program has purchased eight NRL-developed Map-II Stations, and the F/A-18 program has purchased two.

(Lohrenz)

COMPRESSED AERONAUTICAL CHART ACCESS SOFTWARE

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Abstract

The Compressed Aeronautical Chart (CAC) database is a global library of compressed, scanned, aeronautical charts that support Navy and Marine Corps aircraft moving-map displays and mission planning systems. The source for the CAC library is the National Imagery and Mapping Agency (NIMA) standard ARC (equal Arc-second Raster Chart) Digitized Raster Graphics (ADRG) image data set. ADRG is compressed and transformed into CAC via vector quantization and color compression techniques. The Map Data Formatting Facility (MDFF) of the Naval Research Laboratory, Stennis Space Center, MS (NRLSSC), produced the CAC library from April, 1989, until September, 1995, when NRLSSC transitioned the CAC Production System to NIMA.

NIMA distributes CAC installments on Compact Disk Read-Only Memory (CDROM). Each CDROM contains data at one of seven available chart scales, from 1 :5M (M=million) to 1:50k (k=thousand).

CAC data is structured according to the Tessellated Spheroid (TS) map projection system. TS divides the world into five zones (table 2). Each zone is divided into rows and columns of segments, and each segment represents approximately 2 in. x 2 in. of paper chart. The geographic coverage of a segment is dependent on the chart scale and the zone in which the segment is located. The reader is advised to become familiar with these reports prior to using the CAC Access Software.

This report is a programmer's reference for accessing the CAC library via NRL-developed CAC Access Software, which is a user-callable suite of utility programs. The CAC Access Software was written in ANSI C and is currently running under the following operating systems: OpenVMS, Unix, MS-DOS, Windows 3.1, Windows 95 and Macintosh.

(Lohrenz)

DEVELOPMENT OF MINE WARFARE AND GEOACOUSTIC DATA BASES FOR THE REGION SURROUNDING TAIWAN

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Abstract

A high-resolution data base was created by the Naval Research Laboratory for the Naval Oceanographic Office in support of AntiSubmarine Warfare and Mine Countermeasures planning and operations for the littoral region surrounding Taiwan. The complex geology of the region is described on a physiographic province map with a complete explanation. The surficial sediment types, documented in a series of surficial sediment maps, were used in conjunction with a knowledge of basement type and stratigraphic information, as a basis for creating a series of 128 geoacoustic models. These models, which comprise a geoacoustic data base, were validated by comparing acoustic transmission loss calculations with measured data in the Bashi Channel. Finally, mine burial predictions based on surficial sediment information were compared with predictions based on down-core sediment properties measured in the upper 2 m. The results were significantly different, indicating that wherever possible, sediment data as a function of depth should be utilized to obtain reliable mine burial predictions.

(Lohrenz)

DIGITAL MAP REQUIREMENTS STUDY IN SUPPORT OF ADVANCED COCKPIT MOVING-MAP DISPLAYS

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Abstract

This report documents the results of a digital map requirements study that NRL performed for the Tactical Aircraft Moving Map Capability (TAMMAC) Integrated Program Team (IPT) at NAVAIR (PMA 209) in August, 1995. The objective of the study was to establish the map data requirements for a new digital moving-map system being built for the F/A-18, AV-8B, AH-1W, UH-1N, V-22, and potentially other aircraft. A primary NAVAIR goal in specifying the new system was to enhance situational awareness (SA) and aircrew mission effectiveness, without further burdening pilot task workload. To ensure that the end-users' explicit map needs were considered, NRL investigators elicited one-on-one aircrew evaluations of a wide variety of map data types (both topographic and tactical) and map display parameters, including feature size, orientation, color, symbology, etc., to help define an optimum map design for cockpit displays. NRL presented these map variations as a series of 16 demonstrations (on a Silicon Graphics workstation) to 30 pilots and aircrew at the Naval Air Warfare Center in Pax River, MD.

HUMAN FACTORS ISSUES IN THE DEVELOPMENT OF AN ADVANCED DIGITAL MOVING MAP SYSTEM

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Abstract

The U.S. Navy is currently sponsoring a Tactical Aircraft Moving Map Capability (TAMMAC) program that will provide the standard cockpit digital moving map system for Naval Aviation. The TAMMAC system will be used by a variety of Navy aircraft with differing operational needs and resources and can be tailored to meet aircraft-specific operational requirements. A major design goal of the TAMMAC program is to increase mission effectiveness and situation awareness without further burdening pilot workload. Human factors engineering (FWE) specialists from the government and industry have played an important role in the execution of the TAMMAC program throughout all phases. This paper provides examples of the contributions FWE specialists have made to the program, discusses baseline and planned growth discusses human factors issues regarding these capabilities of the TAMMAC digital map computer, capabilities, and identifies future research needs.

(Lohrenz)

OPTIMIZING COCKPIT MOVING MAP DISPLAYS FOR ENHANCED SITUATIONAL AWARENESS

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Abstract

The objective of this project is to establish the map data requirements for a next-generation digital moving-map system that will be designed for installation in the F/A-18, AV-8B, AH-1W, UH-1N, V-22, and potentially other aircraft. A primary NAVAIR goal in specifying the new system is to enhance situational awareness (SA) and aircrew mission effectiveness, without further burdening pilot task workload. To ensure that the end-users' explicit map needs are taken into consideration, investigators elicited one-on-one aircrew evaluations of a wide variety of map data types (both topographic and tactical) and map display parameters, including feature size, orientation, color, symbology, etc., to help define an optimum map design for cockpit displays.

(Lohrenz)

OPTIMIZING COCKPIT MOVING-MAPS FOR ENHANCED SITUATIONAL AWARENESS

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Abstract

Today's military pilots are inundated with information from moving-maps and other advanced cockpit displays. Current cockpit moving-maps are based on scanned charts, which present an unalterable, often-illegible display. Last summer, NRL investigators elicited one-on-one aircrew evaluations of a variety of digital maps and display parameters. The evaluations were conducted at the NAWC Aircraft Division, Patuxent River, and sponsored by the Tactical Aircraft Moving-Map Capability team at NAVAIR to help define specifications for an advanced cockpit moving-map display system. This paper summarizes the results from selected evaluations that most clearly address situational awareness issues.

(Lundberg)

A SEMI-EMPIRICAL LONGSHORE CURRENT MODEL

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Abstract

A semi-empirical longshore current model has been developed that is not reliant upon bathymetry. The model inputs are wave breaker height, wave breaker angle, and the surf width. The output is a cross-shore profile of the longshore current that is consistent with field observations for both planar and barred beaches. Since the model inputs are those that can be readily determined by observation, this model has utility for forward deployed operational forces that may not have ready access to more sophisticated models and measurement techniques. The concept of wave radiation stress was used to provide the driving force in the model. The model was developed and tested from data gathered at Duck, NC during the DELILAH experiment in October, 1990. The beach at Duck had an offshore bar during the data collection. The average absolute deviation of the model compared to the measured data was 19%. The model will require further testing to verify its general application for both plane and barred beaches.

(Lundberg)

VALIDATION OF THE SEMI-EMPIRICAL LONGSHORE CURRENT MODEL

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Abstract

A previously developed semi-empirical longshore current model that does not rely upon bathymetry was tested to determine the validity of the model on both planar (Santa Barbara, CA) and barred beaches (DUCK94 experiment). The only inputs being wave breaker height, wave breaker angle, and surf zone width. The model was further evaluated to determine conditions under which it failed. The results indicate that the model can be generally applied without a detailed knowledge of the bathymetry. Under most environmental circumstances, the normalized average error was 14% - 22%. Based on the DUCK94 data set, the model did not perform as well when wind forcing was strong due to storm passage. It also performed poorly during conditions when the wave breaker height was large and the breaker angle was near zero. Nevertheless, 84% of the predictions had a normalized average error of 50% or less indicating the model is reasonably robust.

(Myrick)

COMPRESSED AERONAUTICAL CHART PROCESSING OPERATOR'S MANUAL

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Abstract

The Naval Research Laboratory (NRL) Map Data Formatting Facility (MDFF) has developed an efficient data processing system that compresses Defense Mapping Agency (DMA) Arc Digitized Raster Graphics (ADRG) data into the Navy-specified Compressed Aeronautical Chart (CAC) database. Much of the software in this system was originally developed by Honeywell, Inc., under contract to McDonnell Douglas Aircraft Co., as part of an airtask with the AV-8B program office at the Naval Air Systems Command (NAVAIR). Since Fiscal Year (FY) 1990, programmers at the NRL MDFF have made significant modifications and enhancements to the original system, which has considerably accelerated the production of the CAC database (Lohrenz, et al, 19__).

This document describes the MDFF CAC processing software from the perspective of an operator who will be processing source ADRG data into CAC data installments. Following the introduction section, this report presents an overview of CAC processing, including a list of acronyms and a brief description of each of the five main CAC processing phases. Next, a section on Operations and Maintenance describes the basic computer system operations with which a CAC processing operator must be familiar. Included in this section are symbol and logical name definitions, directory and file structures, queue management, and related topics. The next five sections detail each phase of CAC processing: INITIALIZATION, PASS 1, PASS2, PASS3, WRAP-UP, and ISO-BUILD. A section on premastering ("ISO Processing") and a Summary follows. A glossary of CAC-specific terminology is provided at the end of the report.

(Myrick)

DIGITAL CHART DATABASE AUGMENTATION WITH SCANNED PAPER CHARTS

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Abstract

This paper presents an overview of a Navy-Developed digital chart database and a system for incorporating data from paper aeronautical charts. The Naval Research Laboratory, Stennis Space Center has developed a compressed database of scanned aeronautical charts, known as the Compressed Aeronautical Chart (CAC) and the Moving Map Composer (MMC) system which enables Fleet users to support aircraft digital moving maps. CAC is designed to be a global, seamless database of digital charts that supports tactical aircraft mission planning systems and navigation systems (i.e., digital moving-map systems). This database has replaced all paper chart and filmstrip products on Navy and Marine Corps AV-8B and F/A-18 aircraft. In addition, several foreign countries, including Australia, Finland, Italy, Kuwait, Spain, and Switzerland have purchased similar aircraft that are equipped with digital moving-map systems and plan to utilize CAC. However, availability of source data for producing CAC is limited at some scales. In areas where paper charts are not yet available in digital form, or the use of foreign paper charts is required, the capability to augment CAC with data from scanned paper aeronautical charts is necessary. A function of MMC will provide Fleet users the capability to augment their CAC database with locally scanned paper charts. This paper also provides an overview of the methodologies used in the development of MMC including data georectification, datum and projection transformations, and scanned data archival.

(Myrick)

USE OF GIS FOR NAVY ANTI-SUBMARINE WARFARE AND MINE COUNTER-MEASURES

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Abstract

This paper describes the methodology used to create and populate a GIS database in support of U.S. Navy anti-submarine warfare and mine counter measures. Scientists compiled relevant information from open scientific literature, since data required for this project was not available in digital form. The software and techniques used to digitize sample points, land areas, sediment types, and physiographic provinces are described. This effort ultimately produced over 5700 features. Quality control and symbology issues associated with such a large and diverse data set are addressed.

(Puleo)

IMPORTANCE OF BORE-GENERATED TURBULENCE TO SWASH ZONE SEDIMENT TRANSPORT

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Abstract

The swash zone is a region where intense fluid/sediment interactions cause sediment suspension and transport that continually reshape local morphology. Swash zone sediment transport is frequently addressed using an energetics argument that was first developed in the 1960's. These simple Bagnold-type formulations were developed for steady, uni-directional river flow where the energy to support the suspended load against the fall velocity was a direct result from bottom shear, and so scaled with the flow velocity. A major source of energy dissipation in the uprush, however, is bore-derived. Hence it might be expected that the uprush suspended load will not scale with the flow velocity. Data from a swash zone sediment transport study conducted on a steep beach has shown the leading edge of the uprush and bore front to be dominated by very high sediment suspension. This present study examines sediment transport in relation to energy dissipation across a bore. A significant drop in energy flux across the bore (most likely manifested through turbulence) was documented and showed a strong correlation to the observed immersed weight sediment transport rate across the bore. Standard Bagnold-type sediment transport formulations did not show strong correlations with either instantaneous immersed weight transport rates or total integrated transport rates as observed in the uprush or backwash. These findings support the concept that standard Bagnold-type formulations are not, in themselves, adequate for describing swash zone sediment transport. Rather, sediment suspension and transport in this region may be significantly influenced by bore-generated turbulence.

ISSUES AND EXPERIMENTS IN DISTRIBUTION OF SPATIAL OBJECTS

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Abstract

In spatial databases, information is naturally distributed due to the nature of the collection process of the data as well as the size of the data. In this ad hoc distribution, the spatial objects are not allocated to nodes in order to improve performance of the database. Few papers have addressed the issue of distribution of spatial data for performance reasons [Abel], though research has been done on how to manipulate spatial data that is already distributed.

Distribution of spatial data presents challenges that do not exist in distributing ordinary data. Spatial objects are more complex than ordinary objects. They can be composed of a single object or a series of objects (for example, an area can be defined by a series of connected lines). This makes the use of an object oriented database, to hold and manage the spatial information appealing. In distributing objects over several machines, the areas of horizontal fragmentation, vertical fragmentation, and replication need to be addressed. This is more complicated than the fragmentation and replication of relational data or ordinary objects because of the complexity of the objects.

Not only is spatial data more complex, but the queries that are performed on spatial data are a superset of regular SQL. The queries include a number of geometric operations, such as 'contains' and 'nearest'. These additional operations make more options apparent for distribution, therefore making the decision about how to distribute the spatial objects more difficult.

In this paper, the issues involved in distribution of spatial objects will be discussed, including how objects in general should be distributed. Additionally, preliminary results from experimentation in distribution of spatial objects will be presented. These will be compared to results of experiments in distributing ordinary objects (those that do not contain spatial attributes).

ISSUES OF UNCERTAINTY IN DISTRIBUTED AND INTEROPERABLE SPATIAL INFORMATION SYSTEMS

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Abstract

Many facets of spatial data representation inherently involve issues of accuracy and uncertainty. This problem is greatly magnified when considering the integration of spatial data from different sources, such as in a distributed or interoperable environment. The general concept of schema merging involves the resolution of incompatibilities as in a distributed environment. These may be either structural or semantic in nature. Structural incompatibilities involve those, for example, in which attributes for representing the same values are defined differently. Semantic incompatibilities, however, represent those cases in which similarly defined attributes have different meanings or values. For example, an attribute of WIDTH for a road in one database may include the width of associated access lanes; while in another database it may be only the main driveable portion of the road. Such semantic issues are much more difficult to resolve, as they require a deeper understanding of the data. We will survey the issues as discussed above for spatial data in such environments and describe several approaches for different aspects of the data using fuzzy set techniques to deal with the incompatibilities.

(Shaw)

MIGRATION PROCESS AND CONSIDERATION FOR THE OBJECT-ORIENTED VECTOR PRODUCT FORMAT TO OBJECTSTORE DATABASE MANAGEMENT SYSTEM

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Abstract

This chapter presents an object-oriented approach for handling Vector Product Format (VPF) mapping databases as produced by the U.S. Defense Mapping Agency. This approach is implemented in the Object Vector Product Format (OVPF) Smalltalk prototype developed by the U.S. Naval Research Laboratory and the University of Florida. OVPF provides an integrated framework for four VPF products: Digital Nautical Chart, World Vector Shoreline Plus, Urban Vector Smart Map, and Vector Smart Map level 0. Having four VPF products and with the update capability, persistent storage of these spatial data was one of the concerns. This chapter will introduce the changes to the data model to accommodate the ObjectStore implementation and migration process of each of the products to the ObjectStore ODBMS.

(Shaw)

ON QUERYING IN DISTRIBUTED SPATIAL OBJECT DATABASES

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Abstract

There is a lot of interest in Geographical Information Systems. They require spatial data types. The complex nature of spatial data makes the Object Oriented approach to modeling the more appropriate for them. So, for databases that contain spatial data, an object oriented database is better suited.

Also, spatial data presents special opportunities and challenges for distribution. Spatial databases for GISs are usually very large. Also, the data is geographically distributed already, so it is more natural to distribute it.

There has been a lot of work on querying in OO databases. Spatial data, however, presents special characteristics that ask for a somewhat different approach. Distribution, of course, adds more difficulties to the query process.

In this paper we will discuss some of the issues that affect querying in each of the areas (distributed, spatial, object oriented) and its intersection. Some experiences will also be presented.

(Shaw)

PC BASED URBAN WARFARE PRACTICE

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Abstract

At the NRL-developed 3D database: http: I /postoffice.nrlssc.navy.rnil/dmap, you can walk inside buildings, view sniper fire angles, threats, etc. and view buildings, street lights, and other features that actually exist at Camp Lejeune. This capability was developed by NRL, from data collected at NIMA St. Louis. The research was funded by the Marine Corps Warfighting Laboratory and initially provided for the Urban Warrior Exercise. At this same site on the first page, click on the GIDB (for Geospatial Information Database), and experience cutting edge mapping database technology/information distribution that will allow you to answer the question, "what mapping data is available for this area-of-interest?" The mapping data will be displayed on your Netscape browser similar to a Geographic Information System.

If you have any questions, problems with firewalls that could limit viewing the site, plug-in questions, etc. email or call Kevin Shaw at NRL, shaw@nrlssc.navy.mil (228) 688-4197.

(Shaw)

UNCERTAINTY ISSUES OF CONFLATION IN A DISTRIBUTED ENVIRONMENT

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Abstract

We have previously considered issues relative to conflation in a geographic information system (GIS) based on the Vector Product Format (VPF) developed by the National Imagery and Mapping Agency (NIMA) as the Department of Defense relational database interchange standard for vector mapping. In this context we developed a knowledge-based system to provide input on both spatial and non-spatial properties of geographic features. Degrees of matching were generated for candidate features based on measurable, objective measures as well as subjective ones. Matches for non-spatial properties (attributes) were generated on the basis of similarity tables developed for the allowed VPF attribute sets. These tables were used in conjunction with a fuzzy combination function to provide the overall degree of matching of the candidate features' attribute/value sets. An expert system also generated weights for the combination function using rules that represented semantic interrelationships of feature attributes.

We are currently developing a distributed object-oriented spatial database at the Naval Research Laboratory. Within this context, conflation is a very evident concern, as the distributed environment entails possible issues of schema (metadata) merging, as well as specific feature data conflation. Our previous approach using an expert system for conflation is not directly feasible in a distributed environment. Hence, we have developed a model of conflation tailored to a distributed environment, for which uncertainty issues handled by our previous conflation system are fully accounted.

(Shaw)

USING VIRTUAL REALITY FOR TRAINING AND MISSION REHEARSAL

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Abstract

It has long been commonplace for military pilots to have access to sophisticated technology for flight simulation and mission rehearsal. Ground troops need similar training tools. The United States Marine Corps (USMC) has such a requirement to provide training and mission rehearsal tools on PCs that can access data stored on a remote server. Virtual Reality Modeling Language (VRML) is available on the PC and does not have specialized hardware and software requirements as do some of the hi-tech flight simulators. This paper discusses a virtual reality capability currently being developed by the Naval Research Laboratory to provide realistic training and mission rehearsal to the USMC.

The data available for this effort is National Imagery and Mapping Agency (NIMA) Vector Product Format (VPF) data which is relational and inherently 2D. VPF data contains both spatial information such as coordinates and topology, and non-spatial information such as attribute values. The 3D components such as height must be extracted from the attributes. Another deficiency is the segmentation of features in VPF. A line feature such as a river is considered in the real world as a single feature, but may be represented in the VPF as multiple features. This representation in VPF causes problems in 3D rendering and feature identification.

This paper will highlight NRL's progress to date in the 3D rendering of spatial information in a fully object-oriented environment. This work has already demonstrated its utility in military mission planning and rehearsal via the Internet/SIPRNET. The discussion will include transformation of relational vector data to objects, persistence of objects in an ODBMS, translation of objects to VRML format, accessing the data remotely over a web browser, 3D rendering of the mission scene using a VRML player plugin to the web browser.

VPF+: A VPF EXTENSION PROVIDING 3D MODELING AND 3D TOPOLOGY

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Abstract

With support from the Defense Modeling and Simulation Office (DMSO) and the National Imagery and Mapping Agency's (NIMA) Terrain Modeling Program Office (TMPO), the Digital Mapping, Charting, and Geodesy Analysis Program (DMAP) has investigated an extension to NIMA's current Vector Product Format (VFF) that would benefit the Modeling and Simulation (M&S) community. In its current form, VPF's Winged-Edge topology is documented as not being capable of modeling a wide range of three dimensional objects that may be transmitted and received through the Synthetic Environment Data Representation and Interchange Specification (SEDRIS). This range of objects includes non-manifold objects found in integrated three dimensional synthetic environments. DMAP therefore proposes VPF+, an extension to VPF that provides for georelational modeling in 3D and that is SEDRIS capable. VPF+ adds a new leveú of topology called Level 4 Full 3D Topology (Level 4). The topologic information encompasses the adjacencies involved in 3D manifold and non-manifold objects, and is described using a new, extended Winged-Edge data structure. This data structure is referred to as "Non-Manifold 3D Winged-Edge Topology." Level 4 also adds a new 3D Object Feature class that is intended to capture a wide range of 3D objects. These features are further defined to be either Well Formed or Not Well Formed, with Well Formed 3D Object Features having additional optional topologic information to improve software performance. Finally, Level 4 implements no changes that alter VPF's Level 0 through Level 3 topology.

(Shaw)

VPF+: A VPF EXTENSION SUITABLE FOR 3D MODELING AND SIMULATION

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Abstract

With support from the Defense Modeling and Simulation Office (DMSO) and the National Imagery and Mapping Agency's (NIMA) Terrain Modeling Program Office (TMPO), the Digital Mapping, Charting, and Geodesy Analysis Program (DMAP) has investigated an extension to NIMA's current Vector Product Format (VPF) that would benefit the Modeling and Simulation (M&S) community. In its current form, VPF's Winged-Edge topology is documented as not being capable of modeling a wide range of three dimensional objects that may be transmitted and received through the Synthetic Environment Data Representation and Interchange Specification (SEDRIS). This range of objects includes non-manifold objects found in integrated three dimensional synthetic environments. DMAP therefore proposes VPF+, an extension to VPF that provides for georelational modeling in 3D and that is SEDRIS capable. VPF+ adds a new level of topology called Level 4 Full 3D Topology (Level 4). The topologic information encompasses the adjacencies involved in 3D manifold and non-manifold objects, and is described using a new, extended Winged-Edge data structure. This data structure is referred to as "Non-Manifold 3D Winged-Edge Topology". Level 4 also adds a new 3D Object Feature class that is intended to capture a wide range of 3D objects. These features are further defined to be either Well Formed or Not Well Formed, with Well Formed 3D Object Features having additional optional topologic information to improve software performance. Finally, Level 4 implements no changes that alter VPF's Level 0 through Level 3 topology.

(Trenchard)

AIRCRAFT OPTICAL DISK INVENTORY ANNUAL REPORT

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Abstract

This report presents the September 1997 edition of the Aircraft Optical Disk (AOD) Inventory, prepared by the Naval Research Laboratory's Moving-Map Composers (MMC) project team. F/A-18 and AV-8B pilots and mission planners use the AODs in cockpit moving-map systems and ground-based mission planning systems, such as the AV-8B Mission Support System. The purpose of this report is to identify the contents of every AOD that has been inventoried by the MMC team, including blank, programmed, broken, and repaired AODs. NRL provides this reference to the Fleet to facilitate identifying the status and contents of AODs in the field.

(Trenchard)

GEOGRAPHIC COVERAGE PLOTS FOR F/A-18 AND AV-8B AIRCRAFT OPTICAL DISK (FOURTH EDITION)

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Abstract

The purpose of this report is to present the geographic coverages of map theaters contained on aircraft optical disks (AOD) built by the Naval Research Laboratory at Stennis Space Center's (NRLSSC) Moving Map Composer (MMC) Laboratory. The MMC team has developed the MMC system which is used to design, build, write and archive map theaters for the AN/ASQ-196 Digital Map System. AV-8B has a single MMC system deployed at each of the following locations: 1) Yuma, AZ; 2) Cherry Point, NC; 3) China Lake, CA; and 4) Indianapolis, IN. AV- 8B also maintains a developmental MMC system at the MMC Laboratory. Also, the Spanish AV-8B maintains 2 MMC systems in Rhoda, Spain and the Italian AV-8B maintains an MMC systems in Grottaglie, Italy. F/A-18 maintains two MMC systems at the MMC Laboratory. These F/A-i 8 MMC systems replace the aging and obsolete Map-Operator-Maintenance Stations (MOMS) that were previously used to build map theaters. NRLSSC only maintains records of the map theaters generated or developed at NRLSSC (which includes all F/A-18 map theaters and some AV-8B theaters). These map theaters contain selected scales of digital map data from the Compressed Aeronautical Chart (CAC) database. The fourth edition of this report includes eleven additional map theaters built since the last edition.

The CAC is a worldwide, seamless, digital map database produced at six scales and distributed by the National Imagery and Mapping Agency (NIMA), formerly the Defense Mapping Agency (DMA). The source data for the CAC is NIMA's ARC Digitized Raster Graphics (ADRG), which is comprised of scanned, aeronautical charts (DMA 1989). The CAC design is optimized to match the resolution of moving-map display systems on the F/A-18 Hornet and AV-8B Harrier aircraft. Map theaters are comprised of selected subsets of the CAC database (Lohrenz and Ryan 1990).

Each map theater contains CAC data for selected scales and geographic areas. The exact coverage of a given map theater is based on Fleet requirements subject to the constraints of the AOD format and media. MMC defines and builds a "master" map theater and assigns it a library number, identified as the AOD image ID. MMC then copies the master map theater onto the specified number of AODs and distributes them to the Fleet as required. Each AOD is a ruggedized Write Once, Read Many (WORM) optical disk that is used in the moving-map display system of the aircraft. Each master map theater is archived until additional AODs are required.

(Trenchard)

INTERFACE CONTROL DOCUMENT FOR MISSION PLANNING
SYSTEM OPTICAL DISK IMAGE VERSION 6+C

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Abstract

This Interface control document (ICD) will fully define the format of the mission planning system optical disk image (MPS ODI) that is created with the NRL SSC Moving Map Composer (MMC) software. The MPS ODI is fully compliant with the format of the AV-8B Night Attack Map Station Version 6+C MPS ODI. Within the AMDS-II development, the MPS ODI is the only interface between MMC and MPS-II. The MPS ODI structure is designed to be backward compatible with the AV-8B 6+C software development. The intent of this ICD is to provide technical detail on the structure of the MPS ODI.

A SPATIAL INDEXING FRAMEWORK USING A QUADTREE ORGANIZATION FOR GEOGRAPHIC DATA STORAGE AND RETRIEVAL

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Abstract

The Digital Mapping, Charting and Geodesy Analysis Program of the Naval Research Laboratory has developed an object-oriented digital mapping database prototype, called the Geospatial Information Database (GIDB). This database application is capable of importing any of the National Imagery and Mapping Agency's (NIMA's) Vector Product Format data and converting the data into an object format. Other supported NIMA data types include Raster Product Format, Text Product Standard, and Digital Terrain Elevation Data. The GIDB supports multimedia data as well, including audio, video, and imagery (GW and JPEG).

Our approach involves partitioning the globe into latitude-longitude cells, since retrieval of objects in the application is always based on a user-defined area of interest. Because any spatially referenced data can be indexed by the quadtree, spatial range queries, i.e., which objects are located within a particular area, are efficiently processed for the multiple data types stored in the GIDB. Each object is defined to have a minimum bounding rectangle, or latitude-longitude bounding box, which is used to determine its placement within a quadtree. In this paper, a brief description of the vector, raster, text, and gridded data types that are stored in the GIDB is presented, followed by a detailed description of the basic quadtree design. The utilization of the resulting quadtree organization is then outlined and discussed; specifically, the method by which objects are placed in the quadtree, as well as the algorithms for object retrieval, are analyzed.

(Wilson)

AN OO DATABASE MIGRATES TO THE WEB

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Abstract

This completely object-oriented language, introduced in the early 1980s, uses a graphical, interactive programming environment. Smalltalk is based on the concept of communicating entities, known as objects. Objects are normally regarded as instances of classes that have attributes and that implement methods for performing operations. Communication between objects occurs when one object sends a message to another, causing that object's method of the same name to be invoked. The ability to define objects that interact in this way enables the incremental development of very complex systems. Starting with just a few objects, programmers can implement basic capabilities quickly, then add to or refine these objects until the system is complete. Smalltalk's interactive environment allows changes to be made, and their effects known, in a very short period. Adele Goldberg and David Robson provide an excellent reference for those wishing to learn more about Smalltalk, and David Smith gives a quick introduction to object-oriented concepts in general.

Since the beginning of NRL's object-oriented mapping work in 1994, we have used ParcPlace-Digitalk' s Visual Works Smalltalk environment, in conjunction with OTI's ENVY/Developer source code manager, to let multiple developers make changes to the source code. Our development platform consists of several Sun Sparc workstations running the Solaris operating system, with one workstation per developer. This has been an extremely effective setup, and continues to be the development environment of choice for the distributed mapping project. Kevin Shaw and colleagues provide more details on the development history of the prototype and the impact of using an OO approach for the project.

DESIGN OF A JAVA INTERFACE TO A SMALLTALK OO MAPPING DATABASE UTILIZING CORBA

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Abstract

The Digital Mapping, Charting and Geodesy Analysis Program (DMAP) of the Naval Research Laboratory has developed an object-oriented (OO) digital mapping database prototype, called the Geospatial Information Database (GIDB), capable of importing any of the National Imagery and Mapping Agency's Vector Product Format data and converting the data into an object format. The DMAP Team has also investigated existing OO technology that would allow the transfer and retrieval of data from the GIDB over the internet. This article describes how we have used a Java applet and the CORBA standard to succeed in our endeavor to make mapping data from our GIDB accessible over the World Wide Web.

(Wilson)

MIGRATION OF AN OBJECT-ORIENTED MAPPING DATABASE TO THE WORLD WIDE WEB

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Abstract

The project was undertaken by the Naval Research Laboratory's (NRL) Mapping, Charting and Geodesy Branch to enhance the ability of Department of Defense (DoD) modeling and simulation users to disseminate digital mapping data/model information in an efficient manner. This project was based on an object-oriented framework developed for the National Imagery and Mapping Agency's (NIMA) Vector Product Format (VPF) digital mapping data. To achieve two goals of the project, cross-platform data dissemination and end-user access from computers of "average" resources, we decided to migrate to a distributed client-server architecture based on the Common Object Request Broker Architecture (CORBA) and the World Wide Web. In this paper we present our implementation of the first phase of this migration, which allows modeling and simulation users, as well as the overall digital mapping community, to access the object-oriented mapping data in a Smalltalk application/database using a Web browser with a Java applet.